

[CLAIMS]

What is claimed is:

1. A method of forming a powder metal material, the method comprising:
compressing at least a portion of an iron-containing metallurgical powder in a die at no greater than 20 tsi to provide a green compact, wherein the metallurgical powder comprises sponge iron; and
sintering the compact.
2. The method of claim 1, wherein the sponge iron includes substantially all of the iron in the metallurgical powder.
3. The method of claim 1, wherein the metallurgical powder comprises at least 10 up to 50 weight percent sponge iron.
4. The method of claim 1, wherein the metallurgical powder further comprises at least one of a pure atomized iron powder and an atomized iron-containing powder.
5. The method of ^{either} ~~any~~ of claims 1 ^{or} ~~and~~ 4, wherein sintering the green compact comprises induction sintering the green compact.

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6. The method of claim 1, wherein the metallurgical powder further comprises no more than 0.3 weight percent of internal lubricant.
7. The method of claim 1, wherein compressing at least a portion of the metallurgical powder comprises compressing at least a portion of the metallurgical powder in a self-lubricating die.
8. The method of claim 1, wherein compressing the metallurgical powder comprises compressing the metallurgical powder at a pressure in the range of 5 tsi up to 20 tsi.
9. The method of claim 1, wherein the green compact has a green strength of at least 1000 psi.
10. The method of claim 1, wherein the green compact has a density of at least 4.0 g/cc.
11. The method of claim 1, further comprising:
hot forming the sintered compact.
12. The method of claim 1, wherein the metallurgical powder optionally includes at least one of:
up to 3 weight percent graphite;

up to 12 weight percent nickel;
up to 3 weight percent molybdenum;
up to 10 weight percent copper;
up to 2 weight percent manganese;
up to 20 weight percent chromium; and
up to 0.3 weight percent internal lubricant.

13. A method of forming a powder metal material, the method comprising:
compressing at least a portion of an iron-containing metallurgical powder in a die to provide a green compact, wherein the metallurgical powder comprises sponge iron and at least one of an atomized iron powder and an atomized iron-containing powder;
sintering the compact.
14. The method of claim 13, wherein the metallurgical powder comprises at least 10 up to 50 weight percent of the sponge iron.
15. The method of any of claim 13, wherein sintering the green compact comprises induction sintering the green compact.
16. The method of claim 13, wherein the metallurgical powder further comprises up to about 0.3 weight percent of internal lubricant.

17. The method of claim 13, wherein compressing at least a portion of the metallurgical powder comprises compressing at least a portion of the metallurgical powder in a self-lubricating die.
18. The method of claim 13, wherein compressing the metallurgical powder comprises compressing the metallurgical powder at a pressure no greater than 20 tsi.
19. The method of claim 13, wherein the green compact has a green strength of at least 1000 psi.
20. The method of claim 13, wherein the green compact has a density of at least 4.0 g/cc.
21. The method of claim 1, further comprising:
hot forming the sintered compact.
22. A powder metal material formed by a method comprising:
compressing at least a portion of an iron-containing metallurgical powder in a die at no greater than 20 tsi to provide a green compact, wherein the metallurgical powder comprises sponge iron; and
sintering the compact.

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23. The powder metal material of claim 22, wherein the sponge iron includes substantially all of the iron in the metallurgical powder.
24. The powder metal material of claim 22, wherein the metallurgical powder comprises at least 10 up to 50 weight percent of the sponge iron.
25. The powder metal material of claim 22, wherein the metallurgical powder further comprises at least one of a pure atomized iron powder and an atomized iron-containing powder.
26. The powder metal material of claim 22, wherein sintering the green compact comprises induction sintering the green compact.
27. The powder metal material of claim 22, wherein the metallurgical powder further comprises no more than 0.3 weight percent of internal lubricant.
28. The powder metal material of claim 22, wherein compressing at least a portion of the metallurgical powder comprises compressing at least a portion of the metallurgical powder in a self-lubricating die.
29. The powder metal material of claim 22, wherein compressing the metallurgical powder comprises compressing the metallurgical powder at a pressure in the range of 5 tsi up to 20 tsi.

30. The powder metal material of claim 22, wherein the green compact has a green strength of at least 1000 psi.
31. The powder metal material of claim 22, further comprising:
hot forming the sintered compact.
32. A powder metal material formed by a method comprising:
compressing at least a portion of an iron-containing metallurgical powder in a die to provide a green compact, wherein the metallurgical powder comprises sponge iron and at least one of an atomized iron powder and an atomized iron-containing; and
sintering the compact.
33. The powder metal material of claim 32, wherein the sponge iron includes substantially all of the iron in the metallurgical powder.
34. The powder metal material of claim 32, wherein the metallurgical powder comprises at least 10 up to 50 weight percent of the sponge iron.
35. The powder metal material of claim 32, wherein the metallurgical powder further comprises at least one of a pure atomized iron powder and an atomized iron-containing powder.

36. The powder metal material of claim 32, wherein sintering the green compact comprises induction sintering the green compact.
37. The powder metal material of claim 32, wherein the metallurgical powder further comprises no more than 0.3 weight percent of internal lubricant.
38. The powder metal material of claim 32, wherein compressing at least a portion of the metallurgical powder comprises compressing at least a portion of the metallurgical powder in a self-lubricating die.
39. The powder metal material of claim 32, wherein compressing the metallurgical powder comprises compressing the metallurgical powder at a pressure in the range of 5 tsi up to 20 tsi.
40. The powder metal material of claim 32, wherein the green compact has a green strength of at least 1000 psi.
41. The powder metal material of claim 32, further comprising:
hot forming the sintered compact.
42. An article of manufacture comprising the material of ^{either} any of claims 22 ^{or} and 32.

43. The article of manufacture of claim 42, wherein the article is one of a bearing, a cam, a gear, and a sprocket.

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